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CLAIMS

1. A piezoelectric motor for moving and positioning a load, the motor comprising:

a coupling surface which is pressed to a load;

a single piezoelectric vibrator coupled to the coupling surface and having a plurality of electrodes; and

a power supply selectively operable to electrify at least one vibrator electrode with time varying voltage to generate vibrations in the coupling surface that step the load to a desired position or to electrify at least one vibrator electrode with constant DC voltage to displace the coupling surface and maintain it displaced and move thereby the load to a desired position.

2. A piezoelectric motor according to claim 1 wherein displacements generated by DC voltage applied by the power supply are substantially collinear.

3. A piezoelectric motor according to claim 1 or claim 2 wherein the DC voltage is controllable to generate displacements that are not collinear.

4. A piezoelectric motor according to any of the preceding claims wherein the vibrator is formed in a shape of a rectangular plate having first and second parallel, relatively large face surfaces and long and narrow edge surfaces and wherein the plurality of electrodes comprises at least one electrode on each face surface.

5. A piezoelectric motor according to claim 4 wherein the at least one electrode on the first face surface comprises four quadrant electrodes each of which covers substantially all of a different quadrant of the face surface.

6. A piezoelectric motor according to claim 5 wherein the at least one electrode on the second face surface comprises a single electrode that covers substantially all the area of the second face surface.

7. A piezoelectric motor according to 6 wherein the single electrode is grounded.

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8. A piezoelectric motor according to any of claims 4-7 wherein the coupling surface is a surface on a short edge surface of the vibrator.

9. A piezoelectric motor according to any of claims 4-8 wherein the power supply electrifies at least one quadrant electrode relative to the single electrode to bend the vibrator in its plane and displace thereby the coupling surface.

10. A piezoelectric motor according to any of claim 4-8 wherein the power supply electrifies quadrant electrodes along a same long edge surface with a DC voltage and quadrant electrodes along opposite long edges with opposite polarity voltage.

11. A piezoelectric motor according to any of claims 4-9 wherein the power supply electrifies quadrant electrodes along a same long edge surface with a DC voltage and quadrant electrodes along opposite long edges are floating.

12. A piezoelectric motor according to any of claims 4-11 wherein the power supply electrifies quadrant electrodes along a same diagonal with a same DC voltage and quadrant electrodes along different diagonals with opposite polarity voltage.

13. A piezoelectric motor according to any of claims 4-12 wherein the power supply electrifies quadrant electrodes along one diagonal of the first surface with a DC voltage and quadrant electrodes along the other diagonal are floating.

14. A piezoelectric motor according to any of claims 4-13 wherein the power supply electrifies quadrant electrodes along one diagonal of the first surface with a DC voltage and quadrant electrodes along the other diagonal are grounded.

15. A piezoelectric motor according to any of claims 1-3 wherein the vibrator is formed the shape of a rectangular parallelepiped constructed from a plurality of thin rectangular layers of piezoelectric material bonded together, each layer having relatively large face surfaces and long and short edge surfaces, and wherein the plurality of electrodes comprises at least one electrode substantially contiguous with each face surface of the layers.

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16. A piezoelectric motor according to claim 15 wherein the coupling surface is located on a short edge of the vibrator.

17. A piezoelectric motor according to claim 16 wherein the power supply electrifies at least one configuration of electrodes with DC voltage to bend the vibrator in the plane of the face surfaces and displace thereby the coupling surface.

18. A piezoelectric motor according to claim 16 or claim 17 wherein the power supply electrifies at least one configuration of electrodes with DC voltage to bend the vibrator perpendicular to the plane of the face surfaces and displace thereby the coupling surface.

19. A piezoelectric motor according to any of the preceding claims wherein DC voltage is controlled to control magnitude of displacement of the coupling surface to resolution equal to or better than a 5 nanometers.

20. A piezoelectric motor according to any of the preceding claims wherein DC voltage is controlled to control magnitude of displacement of the coupling surface to resolution equal to or better than a 2 nanometers.

21. A piezoelectric motor according to any of the preceding claims wherein DC voltage is controlled to control magnitude of displacement of the coupling surface to resolution equal to or better than a 1 nanometer.

22. A piezoelectric motor according to any of the preceding claims wherein DC voltage is controlled to control magnitude of displacement of the coupling surface to resolution equal to or better than a 0.1 nanometer.

23. A piezoelectric actuator for moving and positioning a load, the actuator comprising:

a coupling surface which is pressed to a load to friction couple the coupling surface to the load;

a single piezoelectric vibrator coupled to the coupling surface and having a plurality of electrodes; and

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a power supply operable to electrify at least one electrode of the plurality of electrodes with constant DC voltage to selectively displace the coupling surface along different non-collinear directions and maintain it displaced and drag thereby the load to a desired position.

24. A piezoelectric actuator according to claim 23 wherein displacements generated by the DC voltage applied by the power supply are substantially collinear.